HIGH ENERGY CATHODE MATERIALS FOR THE Li-ION BATTERIES IN THE APPLICATION OF PLUG-IN HYBRID ELECTRIC VEHICLES

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INTRODUCTION

Coprecipitated spherical $Li_{1.2}Ni_{0.2}Mn_{0.6}O_2$ materials are well-known for their large specific capacity (>260 mAh/g), high charge/discharge voltage (2.0 V-4.6 V vs. Li) and high packing density [1]. When combined with $Li_4Ti_5O_{12}$ (1.5 V vs. Li) anode in a full cell, they can provide 2V battery systems that possess excellent cycling performance with high capacity and improved thermal properties. Therefore, high capacity cathode material such as $Li_{1.2}Ni_{0.2}Mn_{0.6}O_2$ is very desirable for rechargeable Li-ion batteries that can be used in applications such as plug-in hybrid electric vehicles (PHEVs) that require 20 to 40 mile electric drive with one battery charge.

EXPERIMENTAL

$Li_{1.2}Ni_{0.2}Mn_{0.6}O_2$ was principally made in two steps: 1) coprecipitation of the spherical $Ni_{0.25}Mn_{0.75}CO_3$ carbonate precursor. the precursor was coprecipitated from a nickel and manganese sulfate solution and a sodium carbonate solution in the presence of ammonia as a chelating agent in a continuous stirring tank reactor. The collected $Ni_{0.25}Mn_{0.75}CO_3$ powder was thoroughly washed, filtered, and dried in a vacuum oven at 120°C for 12 hours; 2) Lithiation of the coprecipitated $Ni_{0.25}Mn_{0.75}CO_3$ by mixing it with Li_2CO_3 and annealing the mix at 900°C for 24h.

RESULTS AND DISCUSSION

Fig.1 shows the discharge profile of $Li_{1.2}Ni_{0.2}Mn_{0.6}O_2$ when it is combined with $Li_4Ti_5O_{12}$ in a full cell at increasing current rates from 0.1C to 1C. The constructed full cell can be charged/discharged within 0.5 and 3.0V and shows around 240 mAh/g specific capacity at a constant discharging current density of 0.1C (charging and discharging for 10 hrs). When the current density increases, the specific capacity shows a very small decrease. Up to current density of 1C, the cell shows ~200 mAh/g capacity with 84% capacity retention.

Fig. 2 shows the cycling performance of $Li_{1.2}Ni_{0.2}Mn_{0.6}O_2/Li_4Ti_5O_{12}$ constructed cell at C/3 rate. The cell shows no capacity loss after 200 cycles and almost 100% coulombic efficiency in each cycle. After charging and discharging for 200 cycles at a constant current, about 225 mAh/g specific capacity was kept.

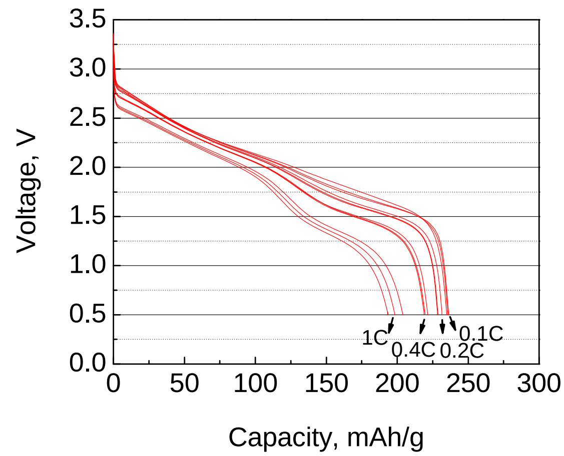

Fig.1. Discharge profile of $Li_{1.2}Ni_{0.2}Mn_{0.6}O_2/Li_4Ti_5O_{12}$ cell at increasing current rates (0.1C to 1C)

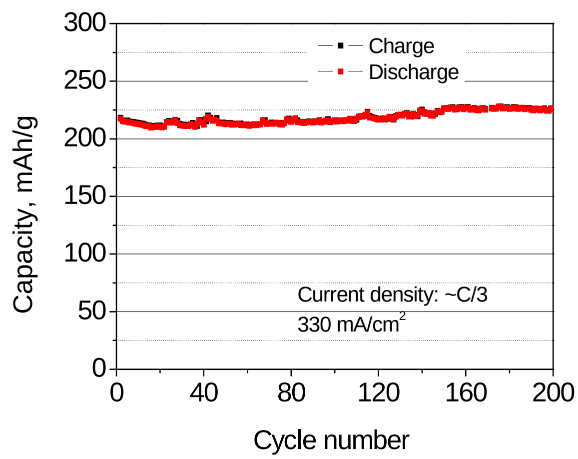

Fig.2. Cycling performance of $Li_{1.2}Ni_{0.2}Mn_{0.6}O_2$/ $Li_4Ti_5O_{12}$ cell at C/3 rate.

REFERENCES

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